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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D. C.

Letter
Circular
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RESEARCH PROGRAM ON BUILDING MATERIALS AND STRUCTURES, 1937-38.

I.- Objectives

1. Law. To carry out the intent of Congress as expressed in the language of the Appropriation Bill, namely to "study the properties and suitability of building materials with particular reference to their use in low-cost housing, including the construction of such experimental structures as may be necessary for this purpose. Provided; that no part of this program shall duplicate any work now being performed by the Forest Products Laboratory of the Department of Agriculture".

2. Sponsors. To fulfill, as far as possible, the intent of the sponsors who requested the appropriation from Congress.

The opinions of the sponsors are expressed in the preliminary report on the program by the Special Group organized by the Sub-Committee on Design and Construction of the Central Housing Committee and in the 162 suggestions received from various agencies of the government. According to this preliminary report, the sponsors believe that:

(a) The results should be made available to the public.

(b) The program should include

(1) Materials, equipment and methods already in use in low-cost housing.

(2) New materials and equipment, and new construction methods.

(c) All available information from whatever source should be included in the reports.

(d) Minimum technical requirements should be established for the elements of a low-cost house. These requirements would be of inestimable value to state and municipal officials.

(e) The tests should be so far as possible under service conditions, and should include the effect of different materials in contact.

(f) The influence of obsolete building codes in restricting the use of new constructions should be determined.

(g) The useful life of each construction should be determined.

In carrying out the investigation these opinions should be followed, in so far as is practicable.

3. General Objective. The general objective may then be restated as follows:

To furnish to government agencies, the building industry, and the public technical information from every available source on the engineering properties of building materials as incorporated in the structural elements and equipment of a house, with particular reference to low-cost housing and including new materials, equipment and methods of construction as well as those already in use.

4. Remarks on the Objectives. It should be noted that the Bureau will not deal with the sociological and economic questions involved, with hygienic or esthetic questions, or with the design of houses. We conceive it to be the function of the social planning agencies to take care of the sociological and economic questions. Public health authorities are already active in studying the hygienic questions, and the design of houses including style and appeal to the public taste lies within the field of the architect. Where it is necessary to touch on these matters in determining the scope of the program, the recommendation of some recognized authority is followed. The Bureau does not presume to endorse or critically evaluate recommendations on these questions, which are not within its field.

II.- Procedure

1. Limitations of Laboratory Tests. It is obvious that the desires of the sponsors cannot be carried out by laboratory work alone. This is especially true of items (d), the establishment of minimum technical requirements, (e), testing under service conditions, (f), the influence of obsolete building codes, and in all probability (g), the useful life of each construction. These problems can be studied most effectively after considerable progress has been made in the laboratory studies. In some cases field surveys of existing houses can be used to supply needed information, for example, as to durability of constructions which have been in use for a long time. This technique cannot, however, be applied to new types of construction, and, in many cases, short-time accelerated weathering tests in the laboratory do not give results which permit the life of a construction under service conditions to be estimated with reasonable accuracy, although such

tests are of value in making comparisons between different constructions.

2. Elements. After numerous discussions with representatives of the housing agencies of the government it appeared expedient for purposes of this investigation to consider a house as made up of elements, i.e., floors, walls, partitions, roofs, heating and ventilating equipment, plumbing, wiring, kitchen equipment, etc., and to consider such elements separately. After determining satisfactory constructions for each element of a house, there remains the problem of combining them to produce a satisfactory house. The combination of a particular wall with a particular roof, for example, might be prohibitive in cost, or have a very short life due to corrosion. However, it seemed that the following advantages would result from the study of the elements of a house:

(a) The data will be more useful to architects and engineers than data on the individual materials of which the elements are composed.

(b) The cost of testing elements will be very much less than the cost of testing full-size houses and the data will be obtained in less time.

(c) The results will approximate closely those obtained on complete full-size houses.

(d) The effect of different materials in contact can be determined.

(e) The data may indicate either that no radically new and different construction is likely to appreciably reduce the cost of a house or that some constructions costing much less than the usual constructions should be investigated further by erecting experimental houses and subjecting them to service conditions.

In so far as possible, each element should be complete, i.e., a portion of a completely finished house. For example, a wall element should be a duplicate of a portion of the wall for a house, one surface ready for exposure to the weather and the other having the finished surface for exposure on the inside of the house.

3. Construction of elements. For this investigation the construction of an element is the design, dimensions, materials, method or process of fabrication, and workmanship of the element. Any appreciable change in dimensions, materials, etc., produces a different construction. For example, an 8-inch brick wall is one construction and the same wall plastered on one face is a different construction.

4. Special problems. Conferences held with representatives of the housing agencies of the government indicated that it was desirable to include in the program certain special problems which do not fall within the plan just outlined for the study of complete structural elements. These problems relate principally to questions of durability, to certain general studies of thermal insulation and ventilation, and to the promotion of simplified practice and commercial standardization of building materials. Thus it is proposed to study the condensation of moisture within walls, its effect on insulating materials, and methods of eliminating it, if possible; the corrosion of steel in wall panels, preparation of steel for painting, and the adhesion of paint; the rain penetration of walls and caulking materials for sealing joints to prevent the entrance of water and air; and the durability of building papers and boards by means of accelerated weathering tests.

III.- Scope

1. General. In fixing the scope, i.e., in determining what materials, methods of construction, etc., shall be included in the program, it is helpful to devise some yardstick to insure that the studies will be made with particular reference to low-cost housing. Fortunately the program for the determination of the technical and engineering properties of the elements of a house does not depend to any great extent upon the number of rooms or their arrangement, upon the architectural effect, upon the relation of the family units to each other, i.e., whether they are detached houses, row houses or apartments in a multi-storied building. Obviously, for each architectural plan problems may arise as, for example, the structural framework and the elevators for a six-story apartment building, which elements may not have been considered in the program. If satisfactory progress is to be made, it seems advisable to simplify the program at the risk of neglecting, for the present, some matters of fundamental importance.

2. Type of House. The program will include elements suitable for single houses, row houses, and low-cost apartment houses. The minimum requirements for structural properties which the elements must meet to warrant further study are determined from the requirements of single houses, but such requirements are merely intended to eliminate constructions which are likely to be unsuitable for any house.

3. Construction. The program will include new constructions as well as the conventional. Although it is true that all the problems relating to conventional constructions have not been solved, the study of conventional constructions will in general be limited to that necessary to furnish a proper basis of comparison for the new constructions. It should be recalled that a new

construction does not necessarily involve a new material but may represent changes in design, dimensions, method of fabrication, or workmanship of an old material.

4. Cost. It has been very difficult to fix a satisfactory yardstick as to cost. Low-cost apartment construction is usually required to meet higher standards, especially as to fire-resistance, than free standing houses in suburban or rural districts, and hence the initial cost of walls or floors per square foot is higher. A study was made of the published information and it was decided to set a maximum for the cost of constructions to be included in the program high enough to include the usual types of low-cost apartment construction, recognizing that the costs should be considerably lower for the free standing suburban or rural house. The sole purpose of the cost limitation is to confine the program to constructions of interest in low-cost housing. The limit should be somewhat liberal to allow for possible economies due to large scale construction. However, every effort should be made to obtain suitable constructions at much lower cost than these maximum figures.

With this understanding of the purpose of the figures and recognizing that the figures are subject to adjustment with changing economic conditions, it has been decided to limit the cost of the constructions to be investigated as fabricated or delivered in Washington, D. C., to the amounts given in Table I. Some elements, i.e., foundations, steps, stairs, etc., are not included in the program at the present time because of limited funds.

Table I. Maximum Cost of Constructions included in Program.
(Costs as of July 1937 in Washington, D.C.)

Element	Maximum cost per sq ft.
Bearing walls	$0.60
Partitions and non-bearing walls	.35
Floors, structural, finish and ceiling below	.75
Roof, structural, covering above, and ceiling below	.60
	Maximum cost per family of four
Heating plant	$400
Lighting	180
Kitchen equipment, including plumbing, refrigeration, and storage equipment	320
Bathroom equipment, including special finish walls and floor, plumbing and fixtures	400

IV.- Detailed Program

The details of the program will be described in a series of separate letter circulars, each covering one general type of activity, for example, structural properties of low-cost house construction.

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